UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

E. C. W. PINE BEETLE CONTROL SPOTTING INSTRUCTIONS

By
Harold Weaver,
Forest Assistant At Large.

March 18, 1935

U. S. GOVERNMENT PRINTING OFFICE: 1935 J 76133

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The following instructions are for the guidance of the spotters and foremen on the E. C. W. pine beetle control projects on the Warm Springs and Yakima Indian Reservations:

I. WHAT THE BEETLES DO TO THE TREE.

Before giving detailed spotting instructions it is best to give a brief description of what the pine beetles do to the tree when they attack it. We will suppose that the beetles have attacked a green pine tree about the first of July of any year. A large number of beetles will make the attack, which will last for from two to three days, until there are at least 15, sometimes 30 or more, on each square foot of bark of the tree. Then the beetles will do the following things:

1. First they will start boring holes thru the bark, usually in the crevices of the bark where it is thinner. When they do this a lot of reddish brown sawdust soon collects in the crevices of the bark on the outside of the tree. It is very noticeable near the ground for it keeps falling down the trunk from the holes higher up. (Remember that the pine beetles attack only the trunk of the tree.)

2. Soon the beetles reach the "cambium layer" of the tree. The "cambium layer" is the living and growing part of the tree, the white, spongy part that is found under the bark, next to the wood. As soon as this layer is reached, the pitch starts running and the beetles have to keep shoving it out of the holes. Soon masses of fresh pitch mixed with reddish brown sawdust collect about the entrances to the holes in the crevices of the bark on the outside of the tree. We call these masses of pitch by the name of "Pitch tubes."

3. As soon as the beetles get rid of the pitch and it stops flowing, they start boring holes that we call "galleries" thru the cambium layer between the bark and the wood. We will assume that this attack is being made by the western pine beetles, Dendroctonus brevicomis, otherwise known as the "brevies" or the "D B's".

The galleries of these beetles cross and recross each other in every possible direction. Within a very few days the beetles will have the tree "girdled"; that is, they will have the cambium layer so cut up with galleries that no more sap can flow. Then the tree is dead, though it may not appear so for a number of days.

4. As soon as the beetles start digging or boring the galleries the female beetles start laying eggs, hundreds of them, along each side of each gallery. The galleries of the western pine beetles are always full of sawdust and other material that we call "frass", but the eggs can be found by looking carefully in the little nitches along the sides.

5. In about one week or ten days the eggs hatch into tiny little worms that we call "larvae". About this time, too, the needles on the tree will start "fading", turning color, first a pale green, then yellowish green.

6. The larvae bore outward, away from the cambium layer, into the middle or "corky" part of the bark. Here they stay until they have reached the size of the adult beetles. If you carefully chip into the bark of an infested tree about this time, you will find hundreds of the larvae. They will have the same color and appearance of grains of white rice. During the time that these larvae are growing the tree is gradually fading from pale green and yellow green to yellow.

7. When the larvae have become fully developed, they go thru the changing or "pupa" stage, in which they form legs, wings and a hard shell that is first light brown, then brown, and finally black in color. We call the beetles in this stage "pupae".

8. When the pupae have formed hard shells and have become black in color, we say that they are in the "young adult" stage. As soon as they have reached this stage, they are ready to come out, "emerge", to attack more trees. When they emerge they bore straight out thru the bark to the open air. After this has happened, the bark of the tree will look like it has been shot with fine bird shot; you will see many tiny little round holes all over the outside of the bark. When you see this you will know that the pine beetles are leaving or have already gone. There are hundreds of other kinds of bugs still left in the tree, but we are not interested in them for they cannot kill pine trees by themselves; they follow the pine beetles after the tree is dead. About this time the tree has faded to a red color in the needles. The time of the year is now early September, which means that in a little over two months after the first attack the new brood of beetles have emerged from the tree to attack more green trees.

Now we will summarize, that is review, the things that have happened to the tree and the beetles in a different way.

Time of Year	What Beetles are doing	Appearance of the Tree
July 1.	Starting to attack, boring holes thru bark.	Needles are green in color like those of any other tree. Fine red sawdust appearing in bark crevices.
July 3.	Beetles have all reached the cambium layer; now are getting rid of the pitch.	Needles are green as ever. Fine sawdust in bark crevices and pitch tubes appearing.
July 6.	Beetles starting to bore galleries thru cambium layer and to lay eggs.	Needles still green. Fine sawdust and pitch tubes in bark crevices.
July 15.	Eggs hatch into small larvae, which bore out into corky part of bark.	Tree now completely dead. Needles now turning to pale green or yellowish green color. Fine red sawdust and pitch tubes in bark crevices.
August 15	Larvae in corky part of bark, almost fully grown.	Needles faded to yellowish color, very little green left in them. Fine red sawdust and pitch tubes in bark crevices.
September 1.	Larvae have changed to "pupae", still in corky part of bark.	Needles changing from yellow to red in color. Fine red sawdust and pitch tubes in bark crevices.
September 10.	Pupae have changed to young adults. Young adults have now mostly left the tree, that is "emerged".	Needles red. Fine red and white sawdust and pitch tubes in bark crevices. Surface of bark covered with many small, round holes made by emerging new adults.

Now we have traced the development of an attack that started on the first day of July and ended early in September. This is only one example. The fact is that the western pine beetles are constantly

attacking new trees from early June to late September or early October. The heaviest attacks occur during the first half of July and the last half of September. This last heavy attack may be cut short by the start of cold weather. Now cold weather does two very important things: First, it stops the activities of the beetles, and second, it stops the fading of the needles of the attacked pines.

Now we will explain the last two statements. Beetles, whether they are eggs, larvae, pupae or adults, require warm weather in which to work. When the weather becomes cold in the fall they go to sleep, "hibernate", for the winter, just like the bears. The most remarkable thing about them is that they can be frozen solid during the winter, but if the temperature does not fall too far below zero for too long a time, they will thaw out in the spring and be as good as ever. When cold weather comes then they go to sleep, in whatever stage they happen to be in. They pass the winter as (1) old adults, who have just attacked the tree, (2) eggs, (3) larvae, in any stage of development, and (4) young adults, ready to emerge next spring. Only one exception can be noted to the above rule: they never seem to pass the winter as pupae. With the coming of the warm weather next spring the old adults of the year before will start laying eggs, the eggs that were laid the fall before will hatch into larvae, the larvae that were hatched the fall before will grow into pupae, etc.

The needles of beetle-attacked trees will not change color during cool or cold weather. Suppose that the beetles attack and kill a tree late in September; then, before the needles have a chance to fade, the cold weather comes. The chances are that this tree will still be as green as ever when the warm weather comes the next April.

Now, with the coming of cold weather in the fall, still another important thing happens. The woodpeckers start drilling holes in the bark to get at the pine beetle larvae. They do some drilling in the summertime, but the other insects are so numerous then that they don't pay so much attention to the pine beetles. Now that the cold weather has come, however, the pine beetles are going to be their main dish for the rest of the winter. By the next spring they will have some of the trees that were attacked the fall before half peeled. It is a common thing in March and April to see beetle-attacked trees ("infested" trees, we say) that appear as follows: The thick bark near the ground will show sawdust and pitch tubes in the crevices. Higher up the tree the thinner bark of the tree will be almost entirely drilled away by the woodpeckers. In spite of all this, the needles will be just as bright a green as those of any other tree and will stay so until the weather becomes warm. We refer to the drilling done by woodpeckers on beetle-infested trees as "Woodpecker work".

II. WHAT TO LOOK FOR WHEN SPOTTING.

Now that we have seen what the beetles do to the pine trees and how the trees look at different times after they are attacked, we will see how our knowledge will help us when we actually go to find them in the woods. We refer to this work as "spotting".

Now we will suppose that we are spotting for control work early in the month of October. We know now that some trees have just been attacked but two or three weeks before. We know that the needles of these trees will show scarcely any fade, if any at all. The only signs that we will see will be the red sawdust and the pitch tubes. Other trees have been hit earlier in the summer and of course they

show lots of fade and are easy to see. Some of them may even look red, though we want to be careful here to see if the beetles have left the tree. Look for the many little round holes; then see, by carefully sampling the bark with your axe, if enough of the beetles remain to make it pay to spot the tree.

Now anybody can see that if the spotters rush thru the woods in a big hurry and spot only the trees that show faded needles they will be missing lots of trees that have been attacked late in the fall. For example: On the Mt. Scott Pine Beetle Control Project on the Klamath Reservation during the fall of 1932, over half of the beetle-infested pines that were spotted showed absolutely no signs of fading in the needles. They were detected by the sawdust and pitch tube signs and by woodpecker work.

The spotters must keep their eyes open. It is assumed that they have good eyesight or they wouldn't be on the job. It is also assumed that they aren't playing along the way, throwing their axes at trees, for instance. They will have to walk back and forth over their strips so that they will pass close to almost every tree. Every group of pines must be inspected closely. Here is what the spotters will be looking for:

1. Faded needles, the easiest sign of all to see.
2. Red sawdust in the crevices of the bark, the hardest to see.
3. Pitch tubes in the crevices of the bark, next hardest to see.
4. Woodpecker work on the bark, sometimes very hard to see.

Sometimes they will find all four signs together, sometimes only sawdust, sometimes sawdust and pitch tubes and sometimes woodpecker work combined. If you hear a woodpecker working up in some pine, be sure to find him and to sample the tree that he is working on.

If you find a beetle-infested tree, or group of trees, be sure to look closely at all of the nearby green trees. They may be full of bugs, too.

If you find a freshly broken or wind-thrown tree, be sure to sample it. Nine times out of ten you will find it full of bugs. Then look closely at the nearby green trees.

If you find lots of tiny round holes on the bark of a tree with faded red needles, sample the bark all around with your axe. If larvae or young adults are still easy to find, spot the tree. If you can't find any, don't spot the tree. If you do spot the tree, you are wasting your time and ours too. We do not care to waste time burning a lot of harmless round heads and spiders.

When sampling a green tree of which you are doubtful, don't swing your axe so that you knock off a great big slab of bark. Carefully chip into the bark until you can see the cambium. If it is white and fresh looking, the tree is O.K. If the bugs are there, you will see their galleries, or the cambium will look discolored. We do have occasional exceptions to this, however. On the Yakima Reservation in particular the bugs for some reason often attack the trunk of the tree higher up, out of reach of your axe. Then if you find that the bark is covered with lots of fine sawdust that has fallen down from above, or if you can see the pitch tubes, or woodpecker work, or faded needles, or any or all of the signs combined, spot the tree, regardless of how the cambium looks.

Remember that the following are the bugs that kill the pines. There are hundreds of others under the bark, on the bark or in the wood, but they are harmless. These are the bugs that we want to kill:

1. The western pine beetles, "brevies".

2. The mountain pine beetles, "monties".

3. The Ips.

4. The redturpentine beetles or valens, seldom found by themselves.

5. Flatheads, found on the Warm Springs Reservation.

Lots of times you will find brevies, monties, Ips and valens in the same tree, but remember that nine times out of ten it is either the brevies or the monties that actually kill the tree.

Remember that your work will be checked in the woods. The best spotter in the world is certain to miss some trees, but if we find too many that you have missed, we will have to conclude that you are either blind or careless.

Don't be afraid to ask questions and remember that skill comes only by practice and close attention.